HOURLY FREQUENCY OF PRECIPITATION IN CENTRAL OHIO AND ITS RELATION TO AGRICULTURAL PURSUITS.

By HOWARD H. MARTIN, Observer.

[Dated: Weather Bureau Office, Columbus, Ohio, July 30, 1918.]

It has been shown by Kincer[1] that the hourly frequency of precipitation and its distribution throughout the daytime and nighttime hours is of importance to the agricultural pursuits of a given State or district. Also, that when grain crops alone are considered, the district favored with a preponderance of nighttime rains is most favorable to farming.

Kincer has also shown that eastern Nebraska, represented by Lincoln, receives 66 per cent of all precipitation occurring between April and September during the nighttime, or between 8 p. m. and 8 a. m., seventy-fifth meridian time; that southern Georgia, typified by Thomasville, receives only 28 per cent; and the Gulf coast, typified by New Orleans, receives only 25 per cent.

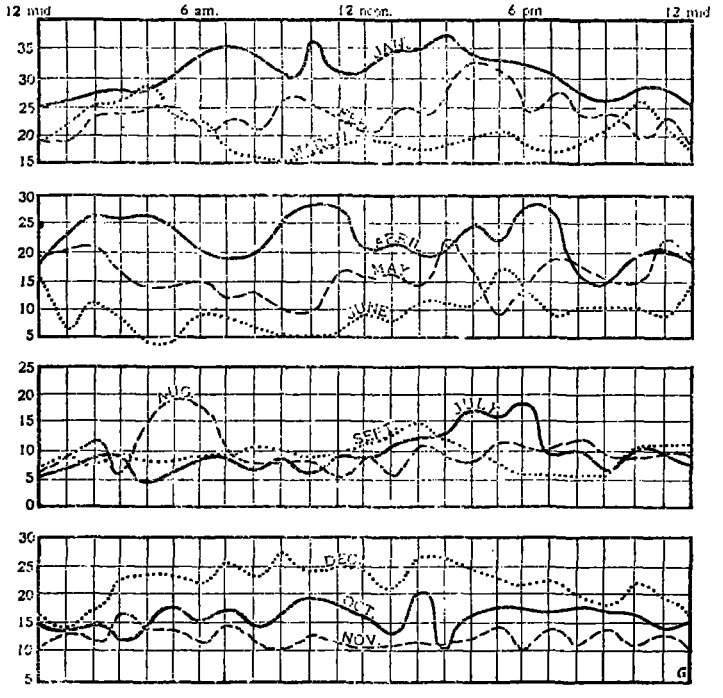

FIG. 1.—Hourly frequency of precipitation at Columbus, Ohio, by months, 1906-1917.

Central Ohio, typified by Columbus, represents an intermediate distribution, 42 per cent of the precipitation that occurs during the growing season being recorded at night.

This might seem detrimental to central Ohio, for, as Kincer further points out:

> After a daytime shower the hot sunshine usually causes rapid evaporation and crusts the cultivated soil, so that little or no benefit and often actual harm results. When the summer showers occur at night, the moisture penetrates the soil to a much greater depth, little evaporation occurs, usually crusts are not formed, and a maximum of benefit results.

Yet central Ohio exceeds eastern Nebraska in the yield per acre of both wheat and corn, 50-year averages considered. With this in mind, it is the purpose of this paper to present by months and by seasons the peculiarities of the diurnal rainfall distribution at Columbus, which, it seems safe to assume, is typical of central Ohio.

Figure 1 represents the hourly frequency of precipitation at Columbus, by months. At first glance there would seem to be no similarity existing between any two of the months, but a closer study will reveal a maximum frequency during the late afternoon hours from January to July, inclusive. There is also a secondary maximum during the early morning hours, at about sunrise or somewhat before. These maxima are not so evident during the other months of the year although they are indicated in the December graph.

Figure 2 shows the hourly frequency of precipitation for Columbus by seasons compared with that for New Orleans, La.[2] Here it is seen that the morning maximum at Columbus is primary during the spring months, attaining its greatest frequency about 1:30 a. m., 90th Meridian Time. In summer the morning maximum (6 a. m.) and the afternoon maximum (5 p. m.) show about the same

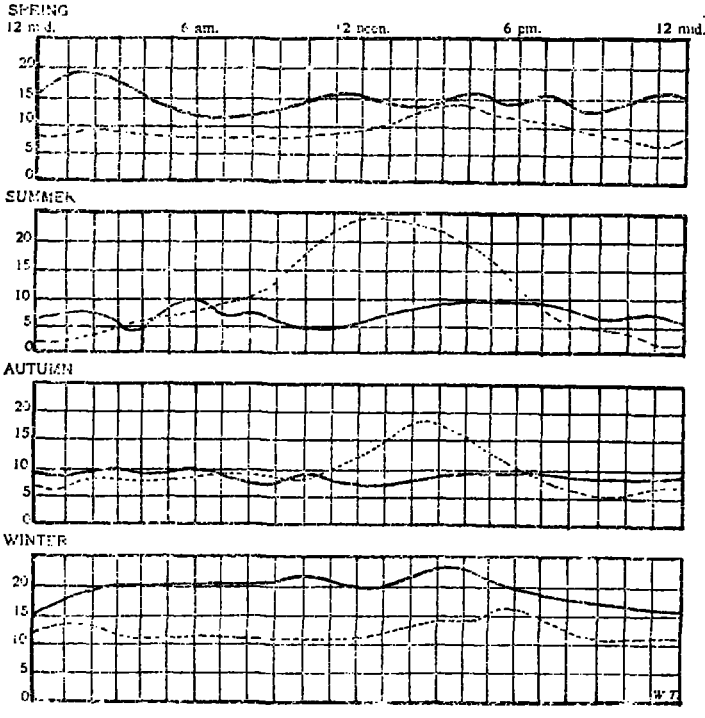

FIG. 2.—Hourly frequency of precipitation in central Ohio compared with that of the Gulf coast. Solid line, Columbus, Ohio; broken line, New Orleans, La., 1906-1917.

frequency, although the afternoon maximum is maintained for a longer period. During autumn it can not be said that there are any pronounced maxima or minima, the frequency values showing a decidedly equable distribution; while in winter, the afternoon maximum again asserts itself, appearing about 4 p. m., or near sunset. The values in this figure have been smoothed by means of the formula, $(a+2b+c)\div 4=F$, where F is the frequency.

It has been found that excessive precipitation in central Ohio is not so frequent as in the Plains States or on the Gulf coast. During a period of 14 years, 1904–17, inclusive, only 76 showers occurred at an excessive rate, the growing season, April to September, considered. The average time of occurrence is 2:30 p. m., the earliest being 12:54 p. m. in May and the latest, 4:54 p. m. in April. It has also been found that the precipitation in central Ohio occurs for the most part in the form of light, beneficial showers. The heavier amounts at ex-

[1] *Kincer, Joseph Burton.* Daytime and nighttime precipitation and their economic significance. MONTHLY WEATHER REVIEW, November, 1916, 44: 628-633.

[2] *Coberly, E. D.* Hourly frequency of precipitation at New Orleans, La., this REVIEW Sept., 1914, 42: 537-538.

cessive rates are often more or less destructive to vegetation and are sometimes accompanied by hail and high winds.

Figure 3 shows a marked difference in the diurnal distribution of the rainfall frequency during the growing season, April to September, for the three districts represented by Lincoln, Thomasville, and Columbus; and

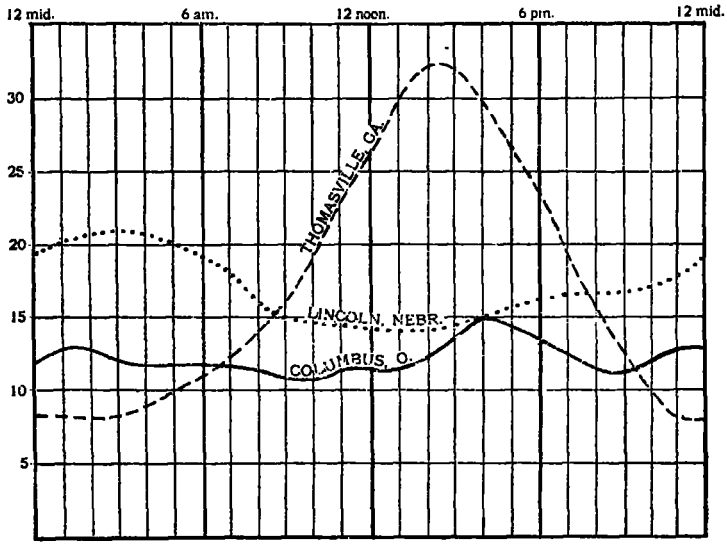

FIG. 3.—Average number of times precipitation occurred by hours, during season, April–September.

figure 4 shows similar differences in the distribution of the hourly amounts of precipitation. At Lincoln the greatest amount of rainfall occurs between 10 p. m. and 2 a. m., while figure 3 shows a corresponding preponderance of frequency of precipitation during the early morning hours, culminating at about 3 a. m., decreasing rapidly throughout the daylight morning hours, and again in-

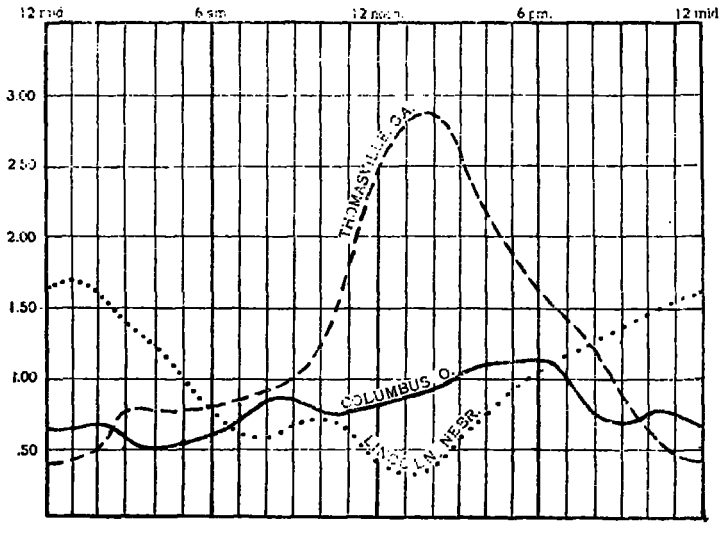

FIG. 4.—Average hourly amounts of precipitation for season, April–September.

creasing late in the afternoon to midnight. At Thomasville the greatest amount falls between 10 a. m. and 6 p. m. During the early morning hours the precipitation is least frequent, increasing rapidly with the advance of the sun, attaining a maximum at approximately 2:30 p. m., and decreasing rapidly until midnight. At Columbus the greatest amount falls between about noon and 7 p. m., with the actual maximum between 4 and 6 p. m. The frequency shows a slight maximum at about 2 a. m., decreasing slightly, then maintaining an equable distribution until about 2 p. m., after which it increases, attaining a primary maximum at about 4 p. m., then decreasing until about 9 p. m., and increasing thereafter.

Rarely during the summer months does a cloudy day follow a nighttime shower. May it not be that precipitation falling two hours before sunset, or thereabouts, will suffer only slight evaporation for a period of 15 hours or more? Consequently the rainfall permeates the soil to a greater extent, and a maximum of benefit results. On the contrary, with the maximum frequency in the morning scarcely three hours before sunrise, the rainfall has much less opportunity to enter the ground to any considerable depth before evaporation takes place under the influence of the sun's rays. There is, of course, probably less crusting of the soil than where showers occur during the early hours of daylight. The total amount of rain falling during the period, April to September, inclusive, is slightly greater at Lincoln than at Columbus; but as previously shown, the distribution at the latter point is more favorable, and this no doubt, together with the greater opportunity for penetration of the soil, contributes to the greater yields per acre in central Ohio to which reference has already been made.

ALLEGED MANUFACTURE OF RAIN IN SOUTHERN CALIFORNIA.

By FORD ASHMAN CARPENTER, Meteorologist.

[Dated: Weather Bureau, Los Angeles, Cal., May 8, 1918.]

During the first fortnight in February, 1918, a professional "rainmaker" began his preliminary advertising activities in southern California. As a result of this publicity campaign one of the commercial bodies of the smaller cities entered into a contract to pay him $300 as a retaining fee and to give him thereafter $1,000 per inch of rain falling during the month of April. This contract stipulated that this rate would hold good up to a total of 5 inches. In order to gain the support of neighboring towns, committees from this organization visited nearby communities and endeavored to enlist their support in the enterprise. Nearly all of those approached referred the proposal to the Weather Bureau at Los Angeles for advice. In discussing the matter with the applicants it was expedient not only to go into the cause of rain in general, but to bring to their minds the history of alleged rainmaking in southern California during the past 20 or 25 years. Fortunately, the writer is personally familiar with the circumstances attending four or five such attempts made in this district during the past score or more of years while he was in charge of the San Diego station of the Weather Bureau and later of the Los Angeles station.

History of local rain making.—The literature of attempts to manufacture rain is so extensive that it is not possible to enumerate even general titles in a brief article. However, all methods as yet proposed are either wholly inefficient, as, for instance, cooling with liquid air, or scientifically absurd, like the exploding of bombs.

The arid and semiarid portions of the United States have been the scene of several attempts at rain making and some of these experiments have been conducted with Federal, State, and municipal aid. Confining our attention to occurrences in recent years, and to activities in the southern part of California, it is found that the rainmaker flourishes in January or February of a season